CHAPTER EIGHT

INTERCHANGES

The information contained in this chapter pertains to the design of ramp connections only. The designer should be familiar with Chapter 10 of the 2004 "A Policy on Geometric Design of Highways and Streets" before beginning the design of any interchange.

The configuration of an interchange should allow all movements to operate at an acceptable level of service as defined in the 1998 "Highway Capacity Manual". The Project Engineer should approve a preliminary design of the interchange before final surveys begin.

CONTROL OF ACCESS AT INTERCHANGES

Control of access along Y lines at interchanges is needed for a minimum of 1000′ beyond the ramp intersections. If for some reason this is not practical, we should provide full control of access for 350′ and then use a raised island to eliminate left turns for the remaining 650′.

LOOP DESIGN 8-1

TYPICAL SECTION:

2′-6″ curb and gutter is placed on the inside of all loops. Pavement widths should be designed to meet Design Widths of Pavements for Turning Roadways see 8-1 Figure 1. Case II (Provision for passing a stalled vehicle).

LOOP DESIGN (Continued) 8-1

SHOULDERS:

See Chapter 1-4D of this manual for width of usable shoulder on outside of loops.

ALIGNMENT:

Freeways - 150′ to 250′ radii unless conditions warrant otherwise. On interstate, loops should be designed for a 30 mph design speed where feasible. (230′ radii minimum for 30 mph design speed).

Expressways - A 150′ radius is acceptable on highways with a 50 mph or less design speed.

Appropriate deceleration and acceleration lanes should be provided for all loops. See Part 1, Section 8-7, Table 1 of this manual. For additional information, see A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2004), ch. 10, for acceleration and deceleration lane lengths.

RAMP DESIGN 8-2

TYPICAL SECTION:

Pavement width is normally 14 feet, but where traffic volumes or truck percentages are high, the designer should consider using a width of 16 feet. On the interstate system, the pavement width should be 16 feet.

SHOULDERS:

See Chapter 1-4E of this manual for width of usable shoulder. Paved shoulders are required on both sides.

ALIGNMENT:

Ramp alignments should be designed to provide room for future loop placement in the quadrants where loops could be placed to eliminate left turns from the Y line onto the ramp. Use a minimum of 170′ to 250′ radii for the future loop. Accommodate for the future loop lane under the bridge as well.

See the sight line and geometric measurements. For additional information, see A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2004), ch. 5. Detail of Measurement of Sight Distance at Ramp Terminals.

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With reduced handrail offsets specified in the Bridge Policy (see Chapter 6-1 of this Manual), horizontal sight distance has become a more critical element of interchange design. The more narrow bridge restricts the horizontal sight line, so that now the ramp terminal location, Y-line grade, and handrail offset must be considered in combination to attain the required sight distance across the bridge. Each interchange design must be individually studied to achieve the most cost effective combination of bridge width, ramp terminal location, and Y-line grade. A 6′ minimum handrail offset will be used on interchange bridges.

There are four basic options available to the designer for providing the required horizontal sight distances.

1. Design the Y-line grade to enable the driver to see over the bridge handrail and guardrail if present. (Chapter 8-7, Table 1 provides K values for Y-Line grades that will enable the ramp vehicle driver to see over the bridge handrail.)

2. Increase the bridge handrail offset and allow the horizontal sight line to fall inside the handrail. (Chapter 8-7, Table 1 provides K values for Y-Line grades that will allow a clear sight line inside the bridge handrail.)

3. Use the minimum handrail offset required by the Bridge Policy (see Chapter 6-1 of this Manual) and locate the ramp terminal a sufficient distance from the bridge end to provide the required sight distance. (The grade on Chapter 8-7, Table 2 shows the distance required from the end of bridge to ramp terminal that provides required horizontal sight distance with various bridge handrail offset distances. Conversely, this graph can show the available horizontal sight distance with set ramp terminals and handrail offset distances. This graph may also be use to derive combinations of handrail offsets and ramp terminal locations that may be necessary in an economic analysis of the interchange layout.)

4. Consider designing grades with the mainline carried over the Y-line.

This design may be cost effective with a narrow median on the mainline and a multilane Y-line. Earthwork costs are usually the critical cost elements in this option.

JUSTIFICATION OF LEFT TURN LANES ON TWO-LANE HIGHWAYS 8-15

The need for a left turn lane on an interchange -Y- line should be carefully evaluated by the designer, since it affects the width of the interchange bridge. The need for a left turn lane is determined by traffic volumes, speed, and safety benefits.

The method for determining the warrants for left turn lanes at unsignalized at-grade intersections (applicable to interchange ramp terminals) is addressed in the attached nomograph. The method utilizes a nomograph based on opposing volumes, left turn volumes, and through volumes. The time delays and queuing characteristics of the traffic volumes are the criteria utilized in establishing these nomographs.

The elements to be used in entering the appropriate nomograph are:

- Operating speed (see A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2004), ch. 2.
- V/o, opposing traffic volume
- VL, left turning volume(VPH)
- Va, advancing traffic volume, including through, left turning, and right turning vehicles (design hour volume).
- VR, right turning volume(VPH)
- S, storage length required

If the intercept of V and Va falls right of the applicable S line, that is the amount of storage warranted.